SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

[No. 1122.—Vol. XXVII.] LONDON, SATURDAY, FEBRUARY 21, 1857. [WITH JOURNAL] STAMPED....SIXPENCE. UNSTAMPED..FIVEPENCE.

WHAT IS A WATER GAUGE?—JUDGMENT.

The important and highly interesting enquiry as to whether the gauge-cocks were or were not a proper water-gauge within the meaning of the 18 and 19 Vict., cap. 108, has at length been brought to a close, and judgment given in favour of the defendants. The additional evidence for the prosecution was Mr. Wm. Fairbairn, of Manchester, who considered the gauge-cocks were not a proper gauge, but admitted, upon being shown a plan of the Dowlais engines, that if a careful engineman, who would try the cocks every half-hour, attended them, there was no danger of their bursting; Mr. Potter, Vice-President of the North of England Mining Institute, who considered the glass gauge the best, and did not think engines so safe without them as with them; and Mr. John Brown, of Barnsley, who admitted that the Dowlais engine shown on the plan would be safely worked by the cocks alone, by a careful engineman, who would try the cocks every quarter of an hour.—This closed the evidence for the prosecution.

Mr. Ebenezer Rogers, of Abercarne, who had had much experience in the practical working of steam-engines, and was conversant with cocks, glasses, and floats, first tried the glass tube, but the glasses became so discoloured by mineral matter that he could not use them—it being impossible to cleanse them by working. He then turned his attention to the float; this answered very well at a pressure not exceeding 30 lbs. to the inch, but, when they wanted a pressure exceeding that, they became inoperative. He found that they could not depend upon them with certainty, and that the men were prone to depend upon them, notwithstanding, and neglected the cocks. From this he had two or three narrow escapes of explosion; and the consequence was, he discarded them, and depended entirely upon the gauge-cocks. From his unsuccessful attempts to use the glass tube and float, he was induced to turn his attention to the subject, with a view of having the best water-gauge, and one that could be depended upon with the greatest degree of certainty, and he found that Watt invented a number of automaton contrivances for supplying water to the boiler, regulating the supply, showing its height, ringing the bell, feeding the furnace with coal, &c. Watt's engines, fitted with the float, glass-gauge, and cocks, had been universally used in Cornwall; but the explosions were of so frequent an occurrence, that a society was formed fifty years ago, similar to that which Mr. Fairbairn had been the means of establishing in Manchester, and the result was, that all automaton contrivances, as indicators of the height of water, had been abandoned; gauge-cocks alone being now used in Cornwall and Devon; and what was the consequence? the explosion of a steam-boiler was now an uncommonly rare occurrence, notwithstanding that they use tubular boilers, and, consequently, were more dangerous on account of the water being near the tubes. He said that the Cornish engineers were far a-head of all others in the country for mining purposes. He considered that the gauge-cock system was decidedly the best and the safest. In reply to some questions, he said he was aware that nearly all locomotive engines were fitted with glass tubes, which was in consequence of the small quantity of water they contained, and not on account of the greater amount of pressure put upon them. From their shape, they were the strongest engines in the world. He considered that a water-gauge was an instrument by which the height of the water in the boiler could be ascertained with sufficient accuracy to prevent accidents from explosion. In his opinion, the gauge-cocks came within his definition.

Mr. Henry Jones, of Old Park Ironworks, Wednesbury, corroborated Mr. Rogers's evidence, and thought the cocks most generally relied upon by engineers. Mr. George Elliott, of Howden Hall, Durham, of twenty years' experience as a mining and civil engineer, said that he had 146 boilers under his management, and considered the gauge-cocks a *proper* water-gauge, and perfectly safe, if properly attended to. Mr. Benjamin Fothergill, Vice-President of the "Association for the Prevention of Steam-Boiler Explosions, and Effecting Economy in the Raising and Use of Steam," said his whole life had been devoted to works connected with engines and machinery, and, from his experience and practice, he was satisfied that the gauge-cocks was the only safe gauge.

Mr. James then addressed the Court, and after quoting two or three passages upon "gauge-cocks" from scientific writers, remarked that in the early part of the proceedings his friend, Mr. Simons, had been very anxious to obtain the history of the steam-engine, but when he ascertained that Mr. Rogers was acquainted with the history of that machine, he became all at once very silent upon the subject, and opposed its being given as evidence. He must say that he was himself agreeably surprised that the Cornish affair had turned out so satisfactorily as it had done. It was now ascertained that engines in Cornwall had had all these appliances of tubes and floats, but at that time they were as dangerous as the Manchester engines now were; but, having discarded them, and returned to the cocks, an explosion in Cornwall, like the experience with the Cyfarthfa engines, had become a matter of history. Why, they had ten times the number of explosions in Manchester that they had in Cornwall, although the Cornish engines were constructed upon a far more dangerous principle. Mr. James then commented upon the several points of evidence, as shewing that, according to the witnesses for the prosecution, the cocks were safe, and could be depended upon if tried sufficiently often—say every quarter of an hour, which was according to the instructions given to the Dowlais engine-men only, they added, better have "two strings to your bow." But he held that one string to the bow was by far the faster, when the second was calculated, as had been shown, to engender carelessness and want of proper attention on the part of the engine-man.

Mr. Simons, in his address, congratulated himself that on the side of the prosecution all the witnesses were agreed—their testimony was in concert and harmony; none of them objected to cocks, but they all considered cocks alone an insufficient gauge; whilst the evidence on the other side was as inconsistent and incongruous as it could well be. No two of the witnesses agreed. Some of them had acknowledged that they had had experience of any other kind of gauge but the cocks, and one of them had actually never seen any other kind of gauge, and he gave that as a reason for believing that the cocks were the best. And then with some of the others, although they condemned the other gauges, and said that engines could be worked better with cocks alone than with other kinds of gauge, or even with the assistance of other kinds of gauge, yet it so turned out that they did not themselves use other kinds of gauges, and never relied upon the cocks alone.

Mr. Fowler, in giving judgment, said that the result of the evidence was this—"If 'proper' be taken to mean safe and satisfactory (which seems to be the meaning most in accordance with the preamble and scope of the statute), neither the glass-gauge nor the float, when used alone, are proper water guages, and the adoption of either, to the neglect of gauge-cocks, would render any person so acting liable to a prosecution like the present. It is true that these witnesses are of opinion that the gauge-cocks alone are not sufficient, but it is held, without exception, that they are quite indispensable to every boiler; and Mr. Fairbairn adds, that if properly adjusted above the danger point, with a reasonably careful engineer, the cocks are a safe water-gauge. It is clear, then, that of all the three contrivances before us, the only one that is seen to be absolutely indispensable, and which in practice may be safely used without any other, is the apparatus of cocks. It further appears that this view of the practical safety of the cock-gauge is confirmed by a great number of practical engineers, who certainly stake their lives daily on the safety of this apparatus. Considering, therefore, all these circumstances, facts, and opinions; looking to the to the object of the Act of Parliament; considering, also, that all the common gauges must have been known to the Legislature when the rule was made, and that any one of them might either have been shut out or distinctly required by the introduction of a single word into it; that, assuming for the present that the rule points only to the use of a single gauge, I think the use of the cock-gauge is not intended to be forbidden, and that the complainant has failed to show, beyond all reasonable doubt, that that gauge is an improper one."

The summonses were, therefore, dismissed, but without costs.

GOVERNMENT SCHOOL OF MINES.

Dr. Percy delivered an interesting lecture on the Composition of Gases evolved from the Blast Furnace, and an elaborate table was shown of the various proportions of the gases at the several feet; these were nitrogen, carbonic aaid, carbonic oxide, light carburetted hydrogen, hydrogen, olefiant gas, and cyanogen. On this subject there had been published several very interesting papers by Ebelmen. There was some difference between the gases evolved by charcoal and those from coal and coke. Anthracite coal was employed at Ystalyfera: there was some difficulty in using this, as it was liable to decrepitate into small dust; the only resource, then, was to let down the fuel and put on a blast. The North American Anthracite had that advantage, that it did not decrepitate. The waste gases always escaped, with a sensible amount of heat; it was a great step to use them as fuel. This plan was first adopted on the Continent, where the fuel was much dearer than in this country, and it was only, comparatively, in later times our ironmasters had availed themselves of this important improvement. The hot-blast had been first introduced in 1830, and since that period the valuable deposits of black-band iron had been utilized. The lecturer here alluded to Mr. Blackwell's labours, and stated that this gentleman had done much to disseminate information on the manufacture of iron. With regard to its fabrication, he might say there had been three great epochs in the iron trade. The first was the introduction of pit coal in smelting, in the 17th century; the second was Cort's process, in 1784; and the third was Neilson's introduction of the hot-blast. Every rail now made was by Cort's process. If iron were exposed to a high temperature it was favourable to oxidation, and carbon and other impurities were freed therefrom. The refining of iron was formerly a preliminary process. In Staffordshire it was seldom used, although in Wales it was more general. A description of the mode of refining iron, illustrated by diagrams, was then given. An analysis of refined iron had given—Iron, 95·14; carbon, 3·07; phosphorus, 0·734; silicon, 0·63; sulphur, 0·157; manganese, a trace; insoluble residue, 0·33, and this contained a little peroxide of iron, silica, and alumina. It was easy to get out the silica entirely; this had been proved by Mr. Nicholson and Dr. Price, long before Mr. Bessemer's process was known. In the slag there was obtained protoxide of iron, silica, and phosphoric acid, and on the top of it could be seen crystals of olivine. The following was the analysis of a refinery cinder: the silica was in this instance partly supplied by the iron, partly by the sand; it consisted of—Silica, 33·76; protoxide of iron, 61·28; protoxide of manganese, 3·58; alumina, 7·3; lime, 3·41; magnesia, 0·76; sulphur, 0·46; dross, 0·45. In the operation of puddling, a reverberatory furnace was employed, and the air allowed to play on the surface. A description of the method of puddling was then given, and some balls from the process shown; these were afterwards passed through rolls, and then became what is called puddled bar. In general good thick coal was used. Some hammer slag is first put in, and spread over the bottom of the furnace; then the operation of puddling takes place. The metal as it becomes decarbonised rises to the surface, and as soon the iron appears to be malleable it is worked by the puddler into balls. The top cinder, which is taken out, is called bulldog, and is used to protect the sides of the furnace: 22 cwts. of pig-iron in Staffordshire will make 20 cwts. of puddled iron. A good puddler will generally earn about 3*l*. per week, besides paying his assistant; and sometimes, if they wish to improve the quality of the metal, they use hematite instead of bulldog. After this the iron is said to come to nature. If the furnace be worked cold, in this case he was told it produced what was called red short. Sometimes the temperature was too low, either by closing the furnace, or its defective state. In Staffordshire, sometimes refined iron was used, but not often. The time required to work a charge was from 1 to 1½ hour. Grey iron permeates the bed of the furnace, and the iron is long coming to nature. Refined iron was used in general for the purpose of making hoop and bar-iron. The working of the puddling furnace, however, depended much upon the quality of the coal employed. At Dudley, they estimated 24 cwts. of pig-iron would give 22 cwts. of puddled bar, and he had seen an instance where 736 tons 11 cwts. 1 qr. 16 lbs. of puddled iron had returned 648 tons 6 cwts. 3 qrs. 4 lbs. of finished iron. He would next allude to Mr. Bessemer's process. He should make but few observations about this, though on it he had his own opinions. The iron was first run down in a cupola, this was afterwards put into a circular chamber, which had been previously heated. Jets of air were then introduced. All goes tranquilly for a short period; a volcanic action then ensues, and the slag is spurted out; after which the iron is tapped into convenient moulds, and, when broken, has a peculiar bright lustre. It is a mistake to suppose that by this process all the impurities are taken away—sulphur and phosphorus still remain; and he would give them an analysis, on the accuracy of which he could rely, which had never been previously published, of the iron produced by Mr. Bessemer's process. This was—Iron, 99·06; phosphorus, 1·13; sulphur, 0·17; carbon, 0·045; silicon, a trace. As he had previously stated, Dr. Price had shown how all the silica could be taken from iron. In the slag there was but a very small quantity of phosphorus. There had been forwarded to him, from Mr. Riley, of Dowlais, some specimens of burnt iron, and these they could compare with that produced by Bessemer's process. The samples were then exhibited, and the fracture and general appearance seemed to be similar to those which were obtained by the method practised by Mr. Bessemer.

On Monday, the lecture delivered by Mr. Warington Smyth was on the Mode of Ascending and Descending Mines. A diagram was shown from the works of Agricola of the system used at the period he wrote in Germany. This was by the ladder, the rope, the sliding staircase, and then, when on an incline, by steps in the rock. This mode was used in the salt mines of Vielieza, in Poland; the same method was employed in the mines of Mr. Beaumont, at Allenheads. Steps were cut in the limestone, and men and horses left the work at the termination of the day's labours. Shafts, however, were more generally employed. In Derbyshire, and in some of the North of England mining districts, a very primitive and rude method was commonly practised. After the stoning had been put in roughly, pieces of wood were driven in at certain distances, and by these the men had to ascend and descend. This was a very insecure method, as a boy, by throwing a stone, could easily displace these. Below this stemples were placed, and with the aid of these the men had to get down the best way they could. In some parts of France a very dangerous method was pursued—a single bar of wood, with staves at the sides: this was called a ladder (*en perroquet*), and the men by this means descended several hundred feet. In metalliferous mines ladders of every kind were used; some of these were good, but others so badly constructed that the men were not only in deadly peril of their lives, but encountered great risks to their health. In some places the staves were of wood, in others they were of iron. These last were very dangerous, as where the waters of a mine were impregnated with sulphuric acid they soon got corroded, and wore away so insidiously that it could scarcely be seen, and the defect was very rarely discovered until some accident had occurred. It had been argued whether a difference of 10 or 12 inches between the staves was the best: those who had long legs, and could make a stride, generally preferred 12 in.; but, on the whole, he thought those of 10 in. were better. In some cases the ladders were placed entirely perpendicular, so as to leave room for the pump-rods and the drawing from the mine; this was, however, very detrimental to the health of the miners. In Belgium they had practised the mode of placing them at angles. In many mines the miners were enfeebled at the age of 40 years, and there was no doubt that in cases their lives were shortened by 20 years, owing to climbing and imperfect ventilation, which engendered diseases of the heart and lungs. If a ladder were placed perpendicular the men had a greater weight to support, and consequently it was requisite that greater exertion should be used. The best angle was that at 70°, and in the shafts where ladders were used, at various distances sollars were placed. In the Hungarian mines the ladders were about 2 fms. long, and in some of the Saxon mines they were as much as 20 fms. in length. In Cornwall the general average was about 5 fms. Some ladders were entirely formed of iron, but these were not in general use, when they came down to the bottom of the mine, and these might be in danger from firing. Chain ladders were occasionally used, and these were employed at the Ecton Mine, in Staffordshire. These either hung loosely or could be stretched. In some countries, where timber was cheap, what were called stump-ladders were in use; these were constructed of a round piece of timber, with notches cut in it, so as to form steps; and in Hungary, America, Norway, and Sweden, they were often met with. Another variety of ladder had been invented by a Mr. Lambert, near Mons; this was on the spiral principle, and something like a corkscrew; it had been found, however, much easier for the men to ascend by this method than by the perpendicular mode. In Belgium it was incumbent in most cases to send the men down by ladders, and this entailed a great loss of time, putting aside the considerations of humanity with regard to the health of the workpeople. For example, in a colliery where there are 500 men, and they have to ascend 1000 ft. high, if the weight be 120 lbs., and they have to travel 1000 ft., this will give 60,000,000 lbs. raised 1 ft. high: 60 men's labour by this is entirely wasted, and reckoning their wages at 3s. per diem, this, calculating 300 working days, would amount to 2700*l*., and would represent a capital of 60,000*l*. to 70,000*l*., the interest of which, if expended in machinery, would have greatly lessened this waste of time, as well as been more beneficial to the well-being of the labourers. In Belgium there was no doubt there were nearly twice as many accidents by ropes, chains, and machinery as by ladders, but it must be borne in mind that many of those whose health is impaired by climbing of ladders, and perish by diseases incurred thereby, do not appear in any statistical tables of accidents. In our own colliery districts, apparently, no time was lost in getting the men to the surface; supposing, however, there was a colliery with 500 men, and they could raise five men at a time, this would make 100 journeys on the rope; taking three minutes as the average time of each journey, this would give 300 minutes, that was five hours; allowing for ascending and descending, this would be ten hours during which the engine would be employed. It is true that at the same period coal could be raised, but this ought not to be practised, as accidents were liable to occur; a piece of coal might fall out and strike some of the men, so as to disable them. Since the Act for the inspection of coal mines was passed no more than eight at a time were allowed to go up in this manner; sometimes three or four would hang on. There had been no correct record kept of these accidents. The *Mining Journal* had published statistical tables of the accidents that had occurred. Although the conductors of that periodical had endeavoured to approximate to a true statement, he believed there were many casualties which had not found a place in their columns. In 1840 the man-engine had first attracted notice in Cornwall, yet ten years previously it had been used in the Hartz. The Sampson shaft, at Andreasberg, was 420 fms. in depth, and it was thought this must be abandoned, unless some plan was adopted for the better and easier ascent and descent of the miners. A mining officer, named Dorell, had hit upon a mode to effect this, by attaching steps to the pump-rods, and to this was given the name of "Fahr-kunst." The Polytechnic Society of Cornwall had offered a premium for the best method of lowering the miners: this was afterwards used at Tresavean, and subsequently adopted at the United Mines, then under the management of the Messrs. Taylor. In Cornwall the men were protected by a boarding, so that they could not fall out. In that county the mode in which this was arranged was most admirable, although it was to be regretted it was not more generally adopted. At Andreasberg, the wire-rope used had 36 wires in the strands at top, and only 12 at the bottom. A good modification of the single rod was used at the Fowey Consols. Diagrams and models of the several engines were then shown and described. The Austrian Government had likewise introduced it in Bohemia, where the Marie shaft was 360 fms. deep. In the Prussian mines at Eisleben two machines are employed, and the shafts are only 90 fms. in depth: many accidents were there avoided. M. Warocque, of Mariemont, had introduced a machine into Belgium: this was a rendezvous for four collieries, and about 700 men daily used it. The shaft there was about 150 fms. in depth, and the whole expense of the gear, inclusive of the engine, was only 1650*l*. The lecturer concluded by stating that these man-engines, apart from the consideration of saving time, were a great desideratum as far as regarded the safety of life, the preservation of health, and the great interests of humanity.

Dr. Percy delivered his concluding lecture for the session on Wednesday. He commenced by stating that in previous lectures he had alluded to the production of steel. In the Museum there was a good model of steel works, which had been presented to the institution by the Messrs. Naylor, Vickers, and Co., of Sheffield. He observed that there were two principles concerned in the production of steel. A description was then given of the furnaces used for its make, illustrated with diagrams. Wrought-iron bars were embedded in charcoal, and a heat applied to them nearly equal to that required for reducing copper. Openings were made in the furnace, from whence trial bars could be taken. The ordinary fuel used was coal. The iron which was mostly converted into steel was that from Sweden and Russia. In the *Journal of the Society of Arts*, 1855, there was an elaborate paper, furnished by Mr. Sanderson, who had long been connected with the manufacture of steel, and which afforded much valuable information on the subject. There was a great mystery observed in England about the manufacture of steel. It was stated the qualities of iron necessary to make good steel depended upon the properties contained in the ores. After cementation, the steel was generally covered with blisters, or bosses; these, however, should not be too large, but uniformly distributed over the bar. Charcoal lumps and dust are used. The charcoal is never employed twice, unless with an admixture of new fuel: if they had entirely fresh charcoal, according to the opinion of the workmen, it was not so desirable; and although, perhaps, they might not be able to enter into the *rationale* of the subject, any suggestions coming from them should be received with attention. The bar of iron was stratified with charcoal; it was put in malleable, and came out extremely brittle. The transverse fracture of crude cement steel exhibits numerous fissures, sometimes of considerable size. The structure was lamellar, the surface granular, and reflected light badly. He next alluded to cast-steel. The furnaces in which this was made were of a simple nature. Stourbridge clay was used in them; this was well known, and of great repute. Derby clay, and that from Standon, had been lately employed: this was mixed with a portion of the old brown pots and some cinder. The steel was then broken up into small pieces, fused, and then cast into moulds. The method of making cast-steel from the iron had been long known to the Hindoos, and Dr. Buchanan had written a very good account of it. The properties of Wootz were as follows—Carbon combined, 1·333; carbon uncombined, 0·312; silica, 0·045; sulphur, 0·181; arsenic, 0·037; iron, 98·093. The advantage of cast-steel was that it was uniform throughout. In many cases you might get the bar partly of iron and partly of steel. If 2 oz. of manganese were mixed with 28 lbs. of low quality bar-steel it would greatly improve it, and give a toughness to it. One of the most important patents on the subject of steel was that of Mr. Heath, which was first patented April 5, 1839. This had been the subject of much litigation, and on it a most elaborate article had been written by Mr. Webster, the eminent patent barrister. In this case the patentee, owing to the defective state of the law, had not reaped the advantages of his invention. Mr. Heath had discovered that 1 per cent. of carburet of manganese mixed with cast steel greatly improved it, and made it weldable. The infringers of his patent used oxide of manganese, with carbonaceous matter.

Dr. Percy next alluded to the German method of making steel; this was very simple, pig-iron was placed on the hearth, and partially decomposed by a blast. The workmen contrived to remove so much of the carbon as to render it steel. Great care and attention was required in this operation. Oxide of manganese, common salt, and clay were used to improve steel in some works. As he was, however, not practically acquainted with this method, he should only allude to it. The colour of steel was various; at about 430 Fah. it was of a pale straw colour, and was then fit for razors and surgical instruments; 470 it was useful for penknives; 490 the colour was brown, and the metal was used for cutting shears, &c.; 510 it was brown, dappled with purple spots, 530 purple; 550 bright blue, fit for swords; 560 blue, fine saws; 600 dark blue, hand pit saws. A description of the method of making tin plates, together with the qualities of iron necessary to be employed, as well as the alloys used, were then given. He would next refer to some of the metals which were not so generally known. In a previous lecture he had spoken of tungsten, and he regretted to say that as yet no practical application had been made of it. He had mentioned Mr. Oxland's process, and had referred them to Aikins's *Dictionary of Chemistry*, where an identical process had been described, 40 years since since. They had endeavoured to alloy copper with it, but had failed; in fact, they could not even adulterate any metal with it. With regard to uranium, there appeared to be no application of it in a metallic state; it was obtained from pitch blende, the greatest deposits of which were at Johan Georgenstadt, on the frontiers of Bohemia and Saxony; they were now becoming scarce; it was highly prized for giving the canary colour to glass. A good account of platinum would be found in Gmelin's *Handbook of Chemistry*, and a series of useful observations had been made on it by Dr. Woolaston; two parts of silver and one of palladium were found to make a good alloy for balancing weights. Those rare metals, osmium and iridium, were used for making the tips of gold pens; they did not spoil the paper, and were almost indestructible. The upper part of the pens were made of an alloy of zinc and gold, commonly called zinc gold. The grains of osmium and iridium required to be of a peculiar size; the large grains were sold at 3*l*. per ounce, while the smaller could be purchased at 15s. per ounce.

He would next speak of aluminium; this was four times lighter than silver, and was now selling in Paris at the rate of 12*l*. per kilogramme; this had been obtained from cryolite, heated with salt and sodium. Some alloys of copper and aluminium were of a yellow colour, and had the appearance of gold; the analysis of two were—No. 1, 95 parts copper, and 5 parts aluminium; No. 2, 90 parts copper, 5 parts zinc, and 5 parts alu-

minium; wherever it was mixed with gold and silver it appeared to spoil it. Some specimens of aluminium were shown, as well as the various alloys. Dr. Percy alluded to the labours of Mr. Deville, and stated that he believed in a few years a more extended application would be given to the use of this metal. They had heard of silicon; the properties of this were as yet but imperfectly known; a short time since some projectors wished to form a company for the purpose of making this, and had shown to an eminent manufacturer in Birmingham specimens of some substance, which did not contain one ounce of it. In conclusion, he would merely state that in his lectures he had endeavoured to be as brief and concise as possible; he trusted, however, he had afforded them some information which they might hereafter find useful, and he could only say that at all times he should be ready to assist them in any way which might be conducive to their advancement in life.

BRISTOL MINING SCHOOL.

The lecture on Monday was by R. Etheridge, F.G.S., on Geology—The Primary Rocks. Mr. R. Etheridge, in commencing, remarked that Geology was the highest and most ennobling of all studies. To make proficiency in it, the student must have an acquaintance with most of the other sciences; and yet if its outlines—viz., the relative position of each stratum, the characteristic fossils, and the few general laws respecting the rocks—be but once thoroughly mastered, what remains is comparatively easy. The study of conchology he would make imperative on the student of geology and mining. If a shell were to be placed in his hands whilst blindfold, he would engage to be able to give from that many important particulars respecting the rocks of the district from which such had been taken. This he did not say by way of boasting, but merely to show what valuable assistance was to be derived from the science of conchology. The history of our planet, before it was clothed with that mantle of vegetation which now adorns it, and became the habitation of man and the contemporaneous tribes of animals, cannot fail to be a subject of interest the most exciting and profound: and geology, in its true and philosophical sense, comprehends the natural history of the earth, the structure of its mountains and valleys, its rivers, seas, oceans, lakes, its fertile plains, and sterile deserts, the successive races of beings who have for countless centuries and ages inhabited its surface, and its seas, and its oceans. In a word, all that belongs to the physical history of the earth is comprised in this science, and it embraces all the great changes of which our planet has been the theatre. The lecturer then proceeded to enter minutely into some of the leading facts and features bearing upon a preliminary introduction to the study of geology, both as regards the physics of the science as well as the study of its organic remains, and its use in a practical point of view—the study of the science thus dividing itself into three great divisions—viz., physical, descriptive, and practical geology. The phenomena to be recognised in the 10 miles of the earth's strata, and the 45 miles of its surrounding atmosphere, the evidences of heat as the result of chemical action, and the truly interesting study of geological chronology, were graphically dwelt upon. In passing from London to North Wales, you traverse over every known rock, save one—the muscle-rock. Russia is as she always has been. Many places have been 33 times submerged and elevated. The wonderful effects of the atmosphere as a destructive, and of water as a destructive and reproductive agent, were clearly set forth. The theory of Elie de Beaumont, accounting for the parallelism and mutually dependent condition of mountain ranges, was explained, and illustrated by various diagrams; as also was that of the effect of volcanic agency in dislocation, protrusion, and overthrowal of the strata. Various specimens of shells and rocks were exhibited, and what would in the hands of many be dry and uninteresting, was made by Mr. Etheridge entertaining and instructive.

FORMATION OF COAL.—Prof. Phillips delivered the fourth lecture of his course on Geology at the Royal Institution on Saturday. In this lecture he considered the successive formations of strata, the order of progression of life at different periods, the formation of coal, and the probable time occupied during the deposition of the series of coal strata. He commenced by stating that one of the leading points in geology on which difference of opinion exists is, whether there was ever a period at which there was no life on the earth. In considering this question, he stated that throughout the whole series of organic remains, from the lowest to the most recent, the same pattern of life is observable, and that, consequently, the same conditions which are now necessary for life must have then existed—light, a certain range of temperature, and an atmosphere. It is only within a very limited range of temperature that life can be maintained; therefore, if the opinion maintained by most geologists—that the globe was at one period in a state of fusion—be admitted as correct, that would determine the question that life on the earth must have commenced after the formation of the lowest rocks. With respect to the order of progressive life, Mr. Phillips showed that the creation of plants must have preceded that of animals, and that, if animal life was progressive, plants must also have succeeded each other in the order of creation; for the fossil specimens of what is considered the highest order are not found in the lowest strata. Thus, for instance, the first specimen of organisation found in ascending from the igneous rock are mosses, and on ascending nearer the surface plants of a more complicated organisation are found. In like manner the fossil remains of animal life perceptible in the lowest series of strata are the zoophites and molluscs; and remains of vertebrated animals do not occur till a much higher class of strata is arrived at. Mr. Phillips adduced these facts as evidence of a progressive order of creation, without, however, expressing his own opinion on the subject. The vegetation of the coal strata is of a peculiar kind, and is not to be found either in the strata above or in those below that series. The plants are allied to those of the growth of tropical climates at the present day, but of a larger size than any living species of the same genera. Tree ferns, equisetæ (horse-tails), pines, and trunks of trees called sigillaria, constitute the largest portion of the organic remains that accompany coal. M. Brogniart has deduced from the peculiar characteristics of the tree ferns which accompany coal that they grew in a tropical temperature, accompanied with abundance of moisture; therefore a very different climate must have prevailed in this country at the time our large coal fields were formed. The fortunate circumstance for this country of large depositions of mineral fuel was contrasted with the state of France in this respect, by geological maps of the two countries exhibiting their respective coal fields; those of France occupying a very diminutive space in comparison with those of England, Scotland, and Wales. In North America, however, the coal deposits far exceed those of Europe. The coal fields of North America extend over an area of 90,000 square miles, while those of Great Britain occupy an area of 5000 square miles. The masses of vegetable remains found in coal leave no doubt that it is of vegetable origin; and, assuming that to be the fact, Mr. Phillips proceeded to calculate the length of time that would be required to vegetate and produce such vast masses of carbon as are deposited in beds of coal. It has been estimated, by observations on growing plants that it would require 25 square feet of surface to produce 1 lb. of carbon, and supposing that the plants grew on the spot, it would occupy 6092 years to make a bed of coal three ft. in thickness. As the beds of coal in South Wales are 120 ft. thick, it would, according to this calculation, have required 243,680 years for the deposition of the whole of the coal strata, which constitute but a small portion of the mass of stratified rocks.

LIQUID QUARTZ.—In the Journal of Jan. 10 we referred to the invention of Count Dembinski for extracting gold from quartz, by dissolving the latter by the aid of carbonate of soda. The chief merit in the invention was the fact that from the soda being recovered after each operation, the cost of extraction was comparatively nothing. One of the products obtained is silicic acid, of the uses of which in the arts, and its general value, Count Dembinski states that, besides being applicable to a variety of industrial purposes, it can be employed for the purpose of silicatising or petrifying wood artificially. Wood having by means of hydraulic pressure been saturated by it, is thus protected from rot, and from being worm-eaten or destroyed by ants. This would be of importance for wood used in building, but particularly for sleepers used in the construction of railways. Wood, simply wetted with dissolved silicic acid, is penetrated by it to the depth of about one-eighth of an inch, and will now take a fine polish of marble or rather agate, giving it a most elegant appearance. Mixed with lime, the dissolved silicic acid forms an extremely hard, insoluble, hydraulic cement, forming silicate of lime. If added to soap in certain proportions, it increases considerably its detergent qualities, giving it at the same time a very beautiful marble-like appearance. The silicic acid, having by the precipitation process, already described, been liberated from all extraneous metallic oxides, metals, and other substances, can be made use of in the manufacture of the finest looking-glasses and crystal glass. In this state of solution, the silicic acid is in the most proper state to be, by means of a simple chemical process, reduced to silicium—a metal perfectly similar to silver in colour, brightness, malleability, and other qualities. It is, however, nobler than silver, because, except by fluorhydric acid, it is, like gold, not attacked by acids. One ton of pure quartz contains about 960 lbs. of metallic silicium, the price of which is at present five times that of silver. These statements refer only to its properties in its liquid state; when calcined and used as a powder, it is said to form, when mixed with oil, a perfectly white and opaque varnish; and from the mathematical formation of its particles, and extreme hardness, it is adapted for grinding, and capable of entirely superseding emery for that purpose.

VEGETABLE CHARCOAL.—Mr. John Stenhouse, Upper Barnsbury-street, improves the preparation of a decolourising material suitable for the treatment of acid, alkaline, and neutral solutions, by producing a highly porous vegetable charcoal, capable of being employed as a decolourising agent in neutral alkaline and strongly acid solutions; it may, therefore be used as a substitute in neutral and alkaline solutions for common bone black, and in acid solutions for what is called purified animal charcoal; purified animal charcoal, as is well known, consists of the porous charcoal, which is obtained by digesting bone or ivory black in an excess of hydrochloric acid, till all the lime salts, consisting of carbonate and phosphate of lime, contained in the bone black, are dissolved out, and removed by edulcoration with water. The porous vegetable charcoal is produced chiefly as follows:—A very intimate mixture is formed of either hydrate of lime, unslacked lime in the state of the finest powder, calcined magnesia, or the light subcarbonate of magnesia of the shops, with certain vegetable substances such as maize, wheat, and other kinds of flour, common resin, or colophonium, pitch, wood tar, asphalte, or bitumen, coal tar, and coal tar pitch. This mixture of lime or magnesia and vegetable matter is then heated to redness in close vessels, that is in ordinary covered crucibles, or in cast-iron retorts, until the vegetable matter is entirely carbonised. The mixture when cold, is then digested with hydrochloric or sulphuric acids, according as lime or magnesia has been employed, and repeatedly edulcorated with water on a filter until everything soluble has been removed. The porous charcoal remaining on the filter is the decolourising agent.

Original Correspondence.

ON THE USE OF ANTHRACITE COAL IN REFERENCE TO THE SMOKE-CONSUMING ACT.

SIR,—In reading the metropolitan police reports lately, having reference to this subject, it is impossible not to be particularly struck with two very important particulars—In the first place, the objections stated by the parties convicted under this Act; and, in the second place, the arguments brought forward by the legal prosecutor on behalf of the Government, in enforcing penalties for the infringement of the same. The victims of this Act say "that Parliament had no right to pass such a measure until it had been clearly demonstrated, and practically proved, that science and mechanical ingenuity had contrived a remedy, and which remedy could at once be made available by all those to whom this act had reference."

The informer, Government prosecutor, and police magistrate, all appear deaf to such logic; for, by their silence, they intimate it may be sound sense but not law; and the penalties are enforced under a most vague and unsatisfactory decision—"that the provisions of the Act have been infringed by the parties not complying with the Act *to the greatest extent in their power*;" or, in other words, they had not up to that time made use of the *then best* smoke-consuming apparatus.

O'Connell used to say "that he could drive a coach and six through any Act of Parliament;" and surely, if the construction of this Act, as thus propounded by the Government prosecutor, is the true reading, our legal Jehus need not despair of repeating such a performance in the present case, with this exception, that it may require a little more care and look-out; for this Act seems more smoky than the subject itself.

I wish to ask this plain question for the benefit and information of all concerned in this matter—Why did not the Government prosecutor, when thus taunted about the unfairness and injustice of this Act, boldly and manfully reply, in some such language as the following—That, "although the Act contemplated the abatement of the smoke nuisance *by mechanical contrivances only*; and though this strange and unaccountable *one-sided view* was the *true legal* interpretation of the Act, yet the complainants had the power entirely to screen themselves from such apparent injustice, as they were really enabled to comply fully with all the provisions of the Act *by their using smokeless coals*." Extraordinary as it may seem, such a remedy as smokeless coal seems to have been entirely overlooked, both by the authors and the victims of this measure; such a singular omission in this Act very much resembles the play of *Hamlet*, with Hamlet (by particular desire) left out! Can, or will any one explain this seemingly mysterious oversight? I have pondered this subject over in various ways, in the hope of finding some solution; and for want of a better, I have come to this conclusion, however uncharitable it may appear, "that class interest is at the bottom of it all." It must be borne in mind that the great coal interest is at the North; it would, therefore, be not very unreasonable to suppose that they have endeavoured to keep this point of the compass even as far south as Westminster. If such should be the case, these coal lords of the North will assuredly find out that such a boxing of the compass will not do for long, for the needle of public opinion in this matter is beginning to point to another quarter, and not all the metal in the British constitution (if it really possesses any), will then be able to effect the least variation.

The framers of this Act appear to be wiser in their generation (in giving such a bias to this measure, by their thus trying to protect the northern coal trade), than those who are liable to conviction under it; for does it not appear passing strange that instead of wandering, as they have done, "from Dan to Beersheba," for a smoke-consuming apparatus, without at last finding one that will meet all the wants of the case, they did not at first bend their steps to that region *where smoke itself is unknown?* Some little excuse, it is true, may be made for such intolerable blindness, in having too implicitly followed, not only blind, but blindly-interested guides, and hoodwinked Acts of Parliament; but now that this legal bandage is a little removed from their eyes, they will only have themselves to blame if they continue to grope much longer for this apparently unattainable apparatus. But even supposing it could be obtained, it would not even then, in the *end, be so simple and economical* as the employment of smokeless coal. How much better, then, would it be for those to whom this Act has special reference to discontinue at once losing their time, wasting their money, and after all exposing themselves to the risk of penalties, by thus trying every new smoke-consuming contrivance that makes its appearance; and in place of such expensive and at the same time uncertain proceedings, expend a little money (a trifle in comparison to their former outlay) in adapting their fire-grates, &c., to the use of anthracite coal; for this coal, which is perfectly smokeless, can now be procured at a moderate cost, owing to the additional number of new collieries that have lately been opened in the anthracite coal district of South Wales; therefore, price ought no longer to be the obstacle, as this coal can be put on board ship at Cardiff for about 10s. 6d. per ton, and the freight to London is upon an average 10s. 6d. per ton, making the total cost of this coal in London (of course, *exclusive* of London charges, which, however, should be only a few shillings) about 21s. per ton. Now, this is really cheap for so valuable a fuel; indeed, much cheaper than bituminous coal, when this important fact is taken into account—viz., that one ton of anthracite coal is equal in consumption or execution to about one ton and a third of bituminous; therefore, to arrive at the *intrinsic* value of anthracite coal, one-third must be deducted from its money price, thus reducing it to 14s. per ton.

However, permit me to give a few words of counsel to those who may feel disposed after such statements as these to make a trial of anthracite coal. In the first place, it is of the utmost importance to procure *pure* anthracite coal, for nothing, I feel convinced, has so long tended to keep this valuable fuel from use as the worthless article that has been too often sold under this name, and which I have little doubt has sometimes been *designedly* done, in order to condemn the genuine commodity. There is a description of coal known as the Welsh stone-coal. This kind of coal must be carefully avoided, as it is as hard as the name it bears, and ignites about as readily as granite itself. Welsh stone-coal has been indiscriminately designated as anthracite coal: it is only a bastard species of anthracite, and, therefore, totally unworthy of the name.

In the second place, as that rookery of vested interests, the "London Coal Exchange," is a *northern coal monopoly*, it cannot be expected that anthracite coal will ever find much favour with such a corporation; and until the Welsh coal interest is sufficiently influential to establish in London a coal exchange of their own it would be most desirable for all large consumers of anthracite to purchase this coal at Cardiff, the Welsh coal port, or through a London agent, connected with the Welsh coal trade, but totally independent of the London Coal Exchange; for such a mode of procedure would not only *save charges* but insure *purity of coal*, two very great essentials, and of equal importance not only to the consumers but to the *producers* of anthracite; for the cry of "mad dog," in reference to this coal, has been so long unchallenged, that it would seem to require some such direct action as this to drown this "northern shout."

I fear I am trespassing upon your valuable time and space, but I feel I cannot satisfactorily conclude without one word in reference to the continuation and extension of the Smoke Consuming Act, more particularly so as there are parties who talk of agitating for its *repeal*, upon the plea that science has not yet discovered a perfect smoke-consuming apparatus. To such dull discerners of the times I fear any argument I might adduce to deter them from such vain endeavours would be as futile as their attempts, the more so as it has so much the appearance of a dodge of the "North countrie," as a last effort to prolong the combined smoke and coal monopoly.

As it is, however, now clearly evident that this Act can be fully complied with by the use of the most natural means—"smokeless coal"—it would be much more rational to talk of its *extension* rather than its *repeal*, and to include under this health-preserving shield all large towns in the kingdom having 20,000 inhabitants and upwards; for there are many other cities and boroughs besides London, Westminster, and Southwark, where the smoke nuisance is equally intolerable. I could name a town not more than 50 miles from London—a locality to which crowds annually repair to escape for a brief season from the weight of that oppressive pall of smoke which mantles everything in this huge metropolis in gloom. But alas! with the exception of the sea breezes, they might, as far as smoke is concerned, have almost stayed at home; for what with the private chimneys of nearly 80,000 inhabitants, and some score of beer and other factories, with their dwarf stacks, pouring forth dense volumes of smoke to such an extent, that without much stretch of imagination one might suppose a stranger, arriving for the first time at that otherwise favoured spot, believing himself to have been conveyed by mistake to some inland manufacturing town. What can the borough Members of that fashionable place be about to allow so serious a drawback to its prosperity thus to continue? Are they afraid of soiling their aristocratic fingers with so dirty a matter, or is it the adverse influence of the "vat tub" that keeps them dumb on this subject in the "people's" or rather (for it is not so at present) the Commons House?

As there are many other towns in England besides the one I have just illustrated to which the extension of the Smoke-Consuming Act would be a great boon, I beg it to be understood that I have not selected the one in question for any other reason than its *position*, being from that cause the most likely place to cite as a familiar example to the majority of your readers. In the present session of Parliament I hope measures may be taken for the extension of this truly beneficial Act, for so it really is, as it concerns health, cleanliness, and cheerfulness. FAIR PLAY.

London, Feb. 9.

PERPETUAL MOTION, AND SCIENTIFIC EDUCATION.

SIR,—Newspaper readers are every now and then reminded, that in the midst of the boasted enlightenment of the nineteenth century, there still exist in London shops entirely devoted to astrological literature, and those of your readers who affect old and curious books will readily remember a shop chiefly famous for works on demonology, and its sister science. The *Mining Journal* itself but too often affords ample proof that real scientific knowledge is not yet sufficiently common to prevent men following impracticable and futile pursuits; and these men, often highly ingenious and of good practical knowledge, who pursue their unfortunate chimera at a sacrifice of laborious thought, valuable time, and money. I allude to the notices, sometimes of the discovery, sometimes of the actual protection by patent, of schemes for obtaining perpetual motion. Such notices alone prove that such delusions are far from uncommon, and I have myself known, personally, half a dozen persons devote their energies to the solutions of the impossible problem; a short statement of the real nature of the question may, therefore, do some little good, and will, at least, be not combating an imaginary evil.

Perpetual motion is to be distinguished from perpetual motors; of the latter several exist, or may exist: a tidal river, or the sea itself, is most probably never in a state of perfect quiescence, and their force might readily be adapted to a perpetual—though not a perpetual useful motion. The mercury in a barometer is probably never in a state of perfect quiescence, though its motion may be so small as to escape observation by the most delicate processes of micrometrical measurement.

But perpetual motion, if it mean anything, must mean this—given a certain finite amount of power, to construct a machine such that acted on by that power, it shall work for ever, or till the parts of the machine itself shall decay, or be destroyed. It is to effect this that all the real attempts at perpetual motion have been directed; and most of those attempts may be referred to three classes—attempts to construct a wheel which shall always have a preponderating weight on one side; to construct a pump which shall work itself by the water it raises; or to construct a machine which shall be worked by the atmospheric pressure acting against a vacuum made and renewed by itself; all these three attempts, as well as any other for the same purpose, are simply impossible and absurd.

Any machine, simple or complex, may be considered as consisting of three parts; firstly, the parts receiving the moving power; secondly, the parts transmitting the moving power; thirdly, the parts acting directly upon the work done; or in other words, the working parts. Now, the first and simplest law of all machines is this—that whether the velocity of the moving power be increased or diminished by the transmitting parts of the machine, the work done upon any machine is equal to the work done by that machine, if we suppose all parts of the machine to be perfectly inflexible, devoid of weight, and to act without friction, or in case of cords without rigidity; or, in other words, under such conditions, power is, by the action of a machine, neither lost or gained, neither decreased or increased. But as these conditions are impossible, as the parts of all machines have weight and flexibility, as cords have rigidity; and as all bodies move on each other with more or less friction, and as these prejudicial resistances must be overcome by the expenditure of part of the moving power, the work given out at the working parts of a machine must be less than the work done upon such a machine; the ratio of the work thus done by the working parts of a machine to work done upon its moving parts has been called the modulus of a machine, and is always less than unity.

In a machine for perpetual motion this work, done by the working parts is applied to continue the action of the machine itself; in other words, it takes the place of the power first applied to the moving parts; but it has been seen that this amount of power has been diminished from the original power by the power expended in overcoming prejudicial resistances; the machine consequently is working with a diminished power; this power is diminished still further every time that the power is transmitted back from the working to the moving parts, till after a certain number of times (dependant upon the modulus of the machine) the power is insufficient to overcome the prejudicial resistance, and the machine (*i. e.*, the perpetual motion) stops. All machines must obey these laws, which cannot be evaded by any contrivance of wheels, water-power, or vacuums. Remove friction, rigidity, and atmospheric resistance, make the parts of the machine without weight or flexibility, and the problem is done; diminish these more and more, and you approach the solution nearer and nearer; but as these can never be destroyed, the problem can never be solved. The peg top made by Roberts, which turned in vacuo on a very fine point, is perhaps the nearest approach to perpetual motion ever made.

Elementary books on mechanics are, I think, responsible for many of the erroneous notions held on this point, by the absurd, but almost universal, customs of calling the lever, pulleys, &c., mechanical powers. A horse, a man, a stream of water, wind, and steam, are all mechanical powers, for all can originate power to perform work, but a lever or pulley can only take the work done upon its moving parts, and transmit it, decreased by friction, &c., to its working parts. They are simply, and should be called simply, mechanical agents; the mere fact of their being called powers must be apt to induce a partially educated man to imagine that they can, of themselves, increase, if not generate, power, and that by some combination of them he can make a machine reproducing the work done upon it.

The persons whom I have known who followed this delusive subject were as follows, and it will be seen that in most of the cases practical knowledge was not wanting, but could not save them from the snare:—

1. A lawyer, a man of great general scientific knowledge, but ignorant of mathematics and mechanics.
2. An inspector of works on a railway, an excellent mechanic, and who, since he abandoned the *ignis fatuus*, has invented several useful machines.
3. A railway contractor, and proprietor of iron chain and wire rope works.
4. A builder.
5. A builder and ironfounder.
6. A working smith.
7. A working millwright.

I may conclude by saying that the above remarks refer to the subject generally, and not to any particular invention or patent, as I have long been of opinion that life is too short to read paragraphs headed "Perpetual Motion" or "Steam Superseded." A. H. PATTERSON, C.E.

Launceston, Feb. 9.

In the analysis of patents for the past year in your last Journal, I notice 38 were for "power obtained from undefined and sundry elements and sources." Most of these were, I fear, for perpetual motion.

MINING AS IT IS, AND AS IT SHOULD BE.—No. II.

SIR,—It has been argued that a director should be paid in the same manner as a secretary or other officer of a company, but, certainly, no one will deny that the duties of a director are totally different from that of any other officer, and to pay a director a fixed salary would appear very like making a merchant or other person in business rely upon a salary instead of his profits for remuneration. The directors are really the acting partners in a company, and as such are entitled to some additional payment out of profits; but all others officers are simply servants, and have, therefore, nothing whatever to do with profits. If shareholders will commit the management of their affairs to incompetent hands they alone are at fault and must ultimately reap the fruits of their bad choice. When the new system had become established no fixed salary would be required, neither would it be requisite, perhaps, to retain the directors in office for seven years, but in the present state of affairs such a course would be absolutely necessary, and, were there ordinary care in the selection, no harm could result. One great cause of evil in mining directorships is, that each being uncertain whether he will continue in office beyond a few months, and not knowing whether all his exertions will prove useless from his successor acting in direct opposition, an amount of lethargy exists which is most detrimental to the interests of the shareholders. In order to secure correct accounts

a public accountant, who makes the auditing of accounts his profession, should in all cases be employed, whether there be shareholders' auditors or not; this would be far more satisfactory than committing that important duty to gentlemen who probably never saw a set of books kept by double entry until their appointment; or, if they had seen them, had not the most remote idea of keeping them themselves, or of proving whether they were correctly kept. The expense of employing a professional accountant would be nothing in comparison with the advantages which would result from it being well known that the accounts were not "cooked."

There is, however, a class of servants employed in the majority of mining companies, to the great detriment of mining, which has perhaps more evil influence upon the public mind, and shakes confidence to a far greater extent, than either incompetent directors or cooked accounts—I allude to share-dealing secretaries, who have been so frequently referred to in the *Mining Journal*, and the means of preventing their mode of action presents some difficulty. It is well known that these persons, acting upon early information, make a larger amount by speculation than from the salary they receive. Now, there appears but one way of at all checking this evil, and that is by appointing trustworthy men, and forbidding the agent to send any information as to the prospects of the mine to the office of the company. This may appear a curious mode of proceeding, but the truth is, that, in many instances, the directors are as bad as the secretary as regards their share-dealing propensities. A weekly report, upon a fixed day, should be forwarded direct to the office of a newspaper, to be named by the shareholders, such newspaper undertaking to publish it verbatim. This would give the whole of the shareholders a nearly equal chance of information, and would, from the secretaries and directors being compelled if they desire early information to employ a private inspector, to a great extent, prevent the sudden rise or depreciation in the value of a property without any just cause, and would save a vast amount of uneasiness and deception with the shareholders—this might be giving the public more information than they have at present, but even if that be an evil it is decidedly a lesser one than that now existing.

That which is required to inspire the capitalist with confidence in mining is the adoption of such a system as shall ensure honour in the direction, trustworthiness in the secretary, and truthfulness in the accounts presented to the shareholders and the public. Few mines managed in London can boast of the accounts from which the shareholder, however perfect may be his knowledge of book-keeping, can, without *referring to the books*, ascertain the true financial position of their affairs—this does not arise from error, but from intentional concealment, which can only be prevented by employing a respectable professional accountant, whose reputation is too valuable to permit him to make a false report. By adopting this system, and engaging a competent secretary, so as to ensure correctness in the books, there would be an effectual check upon every officer, including directors. In my next I will say a few words upon the evil effects of short leases.—*Fulham, Feb. 18.* REFORMADOR.

MANUFACTURE OF IRON.—Mr. G. Dyson, of Tudhoe Ironworks, Durham, has patented an invention for improvements in the manufacture of iron. The conversion of cast-iron into malleable-iron, as very commonly practised in Great Britain and other countries, consists of two processes.—1. Refining; which is performed by melting the pig-iron in a refinery or running-out fire, under the action of a strong current of air. By this treatment the iron is supposed to lose all or part of the carbon with which it is combined or mixed in the state of cast-iron, and also to be freed from other impurities.—2. Puddling; which is performed by melting the refined metal produced by the last-mentioned process in a reverberatory furnace, and when melted, by continually stirring, raking, and agitating it with iron tools by manual labour, until it loses its fluidity, and becomes malleable. It is then formed into lumps or balls, withdrawn from the furnace, and by hammering, squeezing, or rolling, reduced to the shape and dimensions required. It is also now a common practice, especially in England, to perform the two processes of refining and of puddling at once in the same furnace, and this is called "pig boiling." The result is in general nearly the same as when the two processes are separately performed, with such differences as arise from the description and qualities of iron used, and the skill of the workmen employed. By a modification of the manipulation in the puddling or boiling processes, with the addition of suitable fluxes, and the suspension of the operation at a certain stage, the result is that what is called "puddle steel" is produced, instead of malleable-iron. Either or both the above-described processes may be, and have been, partially performed or assisted by the application of mechanical power as a substitute for manual labour, such mechanical power being employed to give a reciprocating motion to a rod, rake, or other suitable instrument for stirring or agitating the melted iron, or to give rotary motion to a tool introduced into the furnace. Now, the invention of Mr. Dyson consists in giving rotary motion to the bottom of the furnace itself, or at least to that part of it which contains the melted metal, and which may be called the basin. The tool or tools introduced are to be kept stationary, and have such forms and such projections upon them as will effectually agitate, stir, and continually bring to the surface fresh portions of the melted metal, until the whole is converted into malleable iron or puddled steel, as may be desired. The process may either be carried out at one operation, or it may be divided into two, three, or more, the furnace being divided into a corresponding number of compartments or chambers—for instance, melting, refining, and puddling, or boiling and balling. The advantages of the invention are considered to be—1. Economy in labour, skilled, and unskilled.—2. Diminished waste of iron, from the shortening of the time required.—3. Diminished consumption of fuel.—4. Increased make with a given number of furnaces and men.—5. Greater certainty and uniformity of quality, and the power of producing puddled steel better than heretofore, at a moderate price.

MANUFACTURE OF COPPER, AND OBTAINING GOLD AND SILVER FROM CUPREOUS ORES.—Henry Hussey Vivian, B. G. Herrmann, and W. Morgan, of the Hafod Works, Swansea, have just specified their improvements in the manufacture of copper, and in obtaining gold and silver from the ores employed in such manufacture. The invention has chiefly reference to the treatment of metallic copper bottoms, derived from the well-known smelting process of selecting or "regule" making up, to the production of which metallic bottoms they introduce no alteration in the smelting of copper ores, whether they be auriferous, argentiferous, or so allied with impurities, as to produce bottoms in the selecting process of greatly depreciated value when reduced to a marketable state. The invention is also applicable to the auriferous, argentiferous, or impure copper of commerce. They describe the method adopted for dealing with such metallic bottoms or copper, which, whether derived from the tapping beds or purchased, is in the state of pigs or blocks. They melt these pigs or blocks, and tap the melted metal into cold water, of which a constant supply must be kept up, so as to cause the metal to assume the form known as "feathered shot;" and to facilitate the after process of calcination, all large pieces should be picked out and re-melted. The metal is next calcined in an ordinary calciner until the whole, or practically the whole, is converted into an oxide—that is to say, until it is susceptible of being pounded to dust in a mortar. An ordinary copper-works' calciner is capable of bringing 3 tons of copper into this state in 72 hours: 1 ton is charged and 1 ton withdrawn each 24 hours, at the end of the calciner most remote from the fire, and advancing it each 24 hours towards the bridge; in the meantime, the granulated copper must be frequently stirred, so as to expose fresh surfaces, and a bright red heat must be kept up. The above is the process of oxidation considered the best, but the metal may be otherwise oxidised, if it be preferred. Having converted the bottom or metallic copper into an oxide, that oxide is mixed with a sulphurous material, and the mixture melted, so as to reduce it into a regulus of copper. They have mixed 26 cwts. of sulphurous copper ore (containing say 30 per cent. of sulphur) with 16 cwts. of oxide, and have converted the oxide of copper into a regulus (of about 40 per cent.) The oxide has also been mixed with raw ore, furnace metal, and silicious matter, and produced a like result. A small metallic bottom is usually produced in this process, which will be found to be rich in gold. It is quite possible to mix a smaller portion of sulphurous metal, and thus to produce less regulus and more metallic copper or bottom; but practice has shown it to be better to reduce nearly the whole oxide of copper to regulus. The regulus is then advanced by calcining and smelting, or by roasting, up to "white metal" of about 70 per cent., and this white metal submitted to the selecting process, so as to produce "light regule" and metallic bottoms. From the ordinary furnace charge of 2 tons, 30 cwts. of regule and 5 to 6 cwts. of bottoms have been obtained with a satisfactory result. These bottoms will be found to contain nearly all the gold contained in the copper or bottom originally operated on. If any sensible amount of gold remains in the regule, a second selecting will remove it, and concentrate it in the bottoms. It has been found that lead, arsenic, and antimony are generally (collectively or separately) present in the auriferous copper bottoms, and that their presence materially facilitates the concentration of the gold in the bottoms. Should neither of these be present, the addition of lead is recommended in the shape of litharge or ore, in the reducing of the oxide to a regulus. The metallic bottoms thus formed are again and again submitted to the process of granulation, oxidation, reduction to regulus, and concentration, by selecting until the gold exists in such a proportion to the copper as to render its separation by any of the well-known methods economical. If the metallic bottom or copper should contain silver alone, it is reduced, as before described, by granulation, oxidation, and smelting with a sulphurous material to a regulus. They are then enabled to submit it to the process in operation at their works, for which a patent was obtained by John Taylor to extract the silver. If the metallic bottoms or copper be both auriferous and argentiferous, they treat the regule derived from each selecting process for silver by their patent, and the bottoms as before described for gold. If any metallic bottom or copper be so alloyed with impurities as to render it of depreciated value, if reduced to a marketable form in the usual way, they granulate, oxidise, and reduce it to a regulus, and are thus enabled to submit the copper as frequently as desired to the selecting process, and thus to obtain from it copper of a superior quality. The inventors claim the reducing metallic bottoms or copper to the state of regulus, and roasting and smelting the same so as to obtain metallic bottoms, in which the gold is concentrated, and is further concentrated by repeating the process; and by which process also a regulus of improved quality is obtained, which may conveniently be treated to separate silver, either by the process for which a patent was granted to John Taylor or otherwise. They also claim the method described for producing a regulus from a metallic bottom or copper, by converting the same into an oxide, and fusing such oxide with a sulphur compound.

CORNISH STEAM-ENGINES.

Abstract from *Browne's Cornish Engine Reporter*, from Dec. 20 to Jan. 24:—

PUMPING ENGINES.	
Number reported	22
Average load per square inch on the piston, in lbs.	15·5
Average number of strokes per minute	6·1
Gallons of water drawn per minute	4467
Average duty of 11 engines, being million lbs. lifted 1 ft. high by the consumption of 1 cwt. of coals	74·8
Actual horse-power employed per minute	1153·7
Average consumption of coals per horse-power per hour, in lbs.	3·1
ROTARY ENGINES.—WHIMS.	
Number reported	17
Number of kibbles drawn	28,435
Average depth of drawing, in fms.	152·0
Average number of horse-whim kibbles drawn the average depth by consuming 1 cwt. of coals	49·3
Average duty of 8 engines, as above	19·0
STAMPS.	
Number reported	5
Average number of strokes per minute	10·5
Average duty of 2 engines, as above	51·4
Actual horse-power employed per minute	55·1
PUMPING ENGINES DOING HIGHEST DUTY.	
Fowey Consols, 80 in. single ... Million lbs.	99·1
Par Consols, 80 in. single ... "	95·4
Great Polgooth, 80 in. single ... "	91·0
Pembroke and East Crinnis, 80 in. single ... "	80·7
West Fowey Consols, 60 in. single ... "	72·1
Trelawny, 50 in. single ... "	73·2
WHIM ENGINES.	
Fowey Consols, 22 in. double ... Million lbs.	28.3
Ditto, 18 in. double ... "	20·9
Ditto, 22 in. double ... "	19·8
Par Consols, 24 in. single ... "	19·4
Great Polgooth, 22 in. double ... "	17·1
STAMPING ENGINES.	
Great Polgooth, 35 in. double ... Million lbs.	58·3
South Caradon, 26 in. single ... "	44·4

MINING IN DURHAM.—The following report on the Green Hurth mineral property was prepared by Mr. Evan Hopkins for the directors of the company working it:—This property is in the county of Durham, at the junction of the counties of Cumberland and Westmoreland, and is bounded on the west by the River Tees. The principal lead-bearing bed on this property, as yet developed, and on which workings are now being carried on, is the scar limestone. The beds above appear too much broken, and not sufficiently covered, to be productive of large masses of mineral; but it is very probable that the beds below, and more especially the Tyne Bottom limestone, will be found productive where the ground is not covered by the scar limestone to the west. The level is about 150 fms. long, from the mouth to the intersection, and was driven above the scar limestone with the expectation of discovering lead ore in the upper beds; but finding the latter not containing any ore of importance, it became necessary to sink about 8 fms. to the scar limestone below, and carry on operations in the vein under the level. It fortunately happens that the upper beds are impermeable, and retain all the surface water; while the beds below are drained by means of the divisional planes and joints, and thus avoid the necessity of pumping, but, in other respects, the workings below the level, and the extraction of the stuff are attended with the usual inconvenience and expenses of workings carried on under level. The level has been driven to the east and to the west for many fms., and several pumps have been sunk therefrom down to the main-bearing bed (scar limestone), and the vein (to the extent I could examine it on the western side) looks exceedingly favourable, and to all appearance very large and strongly impregnated with clear and massive lead ore, in soft ferruginous clayey substance, and capable of producing very large quantities of ore at a cheap rate—that is, if the mine were properly opened out, equal to the width of the vein, and better means of extraction applied. The workings to the east of the intersection appear to have been discontinued for some time, and are closed. The present operations are confined to the west, where they drive only in part of the vein, and take out the lumps of ore as fast as they proceed with the contracted drivage. It is much to be regretted that such a vein, presenting so favourable a prospect to produce large quantities of lead at a cheap rate should be so wrought—*i.e.*, on so limited a scale, and in such an expensive manner, and, more especially, in a locality affording every facility to drive deeper levels. Had such a productive vein been seen in other mining districts, not only several levels would have been driven without loss of time, under the main bearing bed, but also whims would be applied at several points to extract the ore with dispatch, and at a cheaper rate than it can be done in long extraction levels. I cannot see it possible to do justice to the mine nor to the shareholders by the present system of working; therefore, I should strongly recommend another level to be driven further west (say near the shop) and below the scar limestone, and, when this is effected, to carry on the workings in the vein much wider than they now are, so as to ensure the extraction of the whole of the available portion of the vein. Indeed, the vein appears so large, branchy, and soft, that it ought to be worked like some of our iron veins, but this can only be conveniently done when the extracting level is below, and not above the workings. There are many interesting points connected with this property, where exploring works should be carried on; but, until the present workings are brought to a better and more economic system, by means of another level, &c., it would be of no avail to enter into the merits of the deeper beds and other portions of this extensive and valuable property. Not a moment should be lost in commencing a deeper level under the scar limestone, in the bottom of the rivulet near the shop. As this level would become the main extraction, not only from the workings in the vein which is now being explored, but also will drain and extract the ore from several veins which are known to exist farther west, the works should be continued, and I would strongly recommend the level to be made large enough for a horse, lay down iron rails, and instead of timbering the ground, support and keep it open by means of dry walls and arching. The level would thus be rendered perfectly secure, always in good order, and far cheaper in the end than timbering. Although I had no opportunity to inspect what has been done in the east, nor to ascertain why the workings there have been abandoned, I am satisfied there is a large extent of productive ground unexplored towards the eastern boundary. The present deep workings are only fit to prove the character of the lode, and not to carry on the operations of extraction on a profitable scale. I am perfectly satisfied that three times the amount of ore could be extracted at the present cost, had the workings been made wider and if greater facility of extraction had been at command. However, before undertaking any extensive exploring works, I would recommend the shareholders to press on the lord of the manor to reduce the dues. I consider one-sixth far too high a rate of dues for the product of the veins on the beds below the great limestone. However favourable the prospects may be for working the beds from the scar limestone downwards, when we consider the very small [illegible], from the reduced thickness of the ore-bearing beds below—the extra cost attending the extraction—the high price of labour, &c., the prospects are not sufficient to justify one-sixth dues. It is a well known fact and founded on very extensive explorations in this formation, that the great limestone alone has produced as much lead ore as all the other beds put together throughout the whole section from the coal measures above to the old red sandstone below. It therefore follows that 1-12th dues below the great limestone becomes a greater burden on mining operations than the one-sixth above; hence the reason why such dues should be lowered. Were these facts pointed out, I have no doubt but what the dues would be reduced, and the lords would soon find that the immense benefits which would be derived therefrom, by the more extensive and systematic development of their properties, paying a larger amount for dues, profits to the shareholders, and an increased employment and prosperity to the population of the district. It will therefore be observed that the profitable prospects of Green Hurth do not depend so much on the rich appearance of the present workings, as they do on reduced dues, a better system of working, and more extensive development of the veins.

BRIDGES AND GIRDERS.—Mr. W. Humber's "Practical Treatise on Cast and Wrought-iron Bridges and Girders, as applied to Railways and other Structures," is proceeding very spiritedly. The seventh part has just been issued, by Messrs. Spon, Bucklersbury, and contains plates of the bridge over the Great Northern Railway in Biggleswade, by Joseph Cubitt, C.E.; and of the tubular girder bridge, designed by George Willoughby Hemans, C.E., and erected by Messrs. W. Fairbairn and Sons, over Lough Atalia, on the Midland Great Western Railway, Ireland. Descriptions are also given of the Rhymney Railway Bridge, in Cardiff, by Joseph Cubitt, constructed by Mr. Charles Gordon, of Newport; the Wakefield, Pontefract, and Goole Railway Bridge, over Knottingly and Goole Canal, by John Harris, C.E.; the South-Eastern Railway Bridge, over the River Stour, by Peter Ashcroft, C.E.; and the Strood and Maidstone Railway Bridge, over the Creek at Strood, by Montague Harrison, C.E., constructed by Messrs. J. and W. Horton.

self yesterday thoroughly examined the mine, particularly the parts of the lode excavated by the ancient workmen said to be done about 40 years ago, when the blende over the Frongoch deposit of lead ore was worked, it is said by the same person, Mr. Sheldon, and there are various points of analogy between these deposits, which I shall further allude to before concluding this notice. We found the excavations extended along the length of the lode for about 40 fms., we could not see the bottoms of the different sinks, but they are said to be about 10 fms. deep. The main excavations are about 20 fms. long each, and are separated by a piece of unwrought ground in which the shaft is situate for drainage and drawing; the length of this piece of unwrought ground is from 10 to 12 fms., and it is possible that this ground may prove productive, as the cross-cut from the bottom of the shaft, which is 17 fms. under the surface, has passed into lode-stuff, chiefly carbonate of lime highly crystallised, and branches of blende. I mention this as this shaft unquestionably is well situate for draining both excavations, and therefore well selected in that respect, and may also be nearer productive ground to the eastward than it appears to be at the surface. We were struck by the very expensive mode of operation of the old men; the borer holes were quite small, placed close together, and very short; it would be easy with borers of proper size, to blow down 20 times as much ground at one blast as they did, and when we take into consideration that the blende, the produce of these holes, had to be reduced to powder by hammers in the hand of girls, perhaps a couple of barrows full a-day, and that a crushing mill attached to your present wheel would crush 60 tons a day, or 700 times as much as a girl, and that at scarcely any cost, it is easy to be conceived that if the mine could be worked to any advantage then, with anything like similar prices for the blende, that considerable profits ought now to be made. We looked carefully into the lode, which is from 20 to 30 ft. wide, and we found it composed of carbonate of lime, thickly traversed with good solid ribs of blende, mixed with fresh and beautiful gossan, carrying rich lead in small quantities, but I was particularly struck with the freshness of the crystallisation, clearly showing that the upper section of the lode is at this moment acted upon by the mineralising agency that collected the formation, and I am convinced from this cause and effect, so apparent now that the excavations have been so long opened, that there is a mass of lead below, and that the whole mass of blende is resting upon another metal. The whole quantity of lode drained by the shaft, say for a depth of 17 fms., may be fairly taken at 3400 fms., and if we subtract from this 1000 fms. for ground already worked, it would give 2400 fms. of the ground to work away, without taking into consideration discoveries, or the lengthening of the ore ground through the unwrought portion of the vein. I understand the price of blende is now £4 per ton, and I apprehend that it was about the same price when the ground was worked away in a manner that appears to us so unskilful; if so, the ground must have yielded 1½ ton of blende to a fm. on an average, to have paid the cost; but if it yield 1 ton to a fm., Captain Barbery, Capt. Lester, and myself, calculate that it ought to leave one half profit, as the ground ought to be broken for £1 per cubic fm., and the other expenses would be nearly covered by another £1; but if it leave one-third profit, it would be equal in remuneration to most lead mining in this country, so that there is nothing left for me but to recommend the company to prosecute the mine without delay and effectually. There is a shaft sunk unwatering the lode to a depth of 17 fms. There is a good water-wheel, 30 ft. diameter, 4 ft. wide, erected, and a very good arrangement of offices, storehouses, smithy, and carpenters' shop, and outhouses, all very well built and convenient. I must here do an act of justice to the agents, or agent, that selected the site of the water-wheel. I saw the subject mentioned by Mr. Ennor in the *Mining Journal*, in a way not only to cast opprobium on the judgment of the agent, but to carry dissatisfaction into the minds of the shareholders. I beg to assure the shareholders that there is not the slightest foundation for any censure with respect to the fixing of this wheel and machinery. I have had great experience in this class of engineering, and I consider the position of the wheel, for the purposes to which it is, and is to be applied, the best that could be obtained. The work to be done is to apply to this wheel a good 30 or 32 in. pair of crushing rollers, working one round to three of the water-wheel. A good flooring, well supplied with jigging hutches, buddles, with sheds, railroads for delivering the stuff where required—these together, would cost £350; and I should say £150 would be enough to put the excavations or underground work in working order, for it is only to break down the sides and open the lode like a quarry; and the walls, I should say, would stand with little timber for 100 ft. deep—say altogether, £500. And I should say, in three days after the crushing mill goes to work, the carriers may be ordered to the mine to take away the clean blende, in quantities of two or three tons per day. With reference to East Castell Mine, I have forwarded my report to Mr. Thomas, and I see no reason to change my views, but with the present price of blende. I should recommend you to stick to the Castell Mine as a safe and speedy medium of profits. I ought to say that the ground below the crusher is most favourably formed and situated for an extensive and cheap dressing floor, a valuable requisition in any, but especially in a blende mine.

MATTHEW FRANCIS.

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